Freie Universität Berlin

Climate Policy

Choosing the right instrument to reap an additional employment dividend

Ronnie Schöb

School of Business & Economics

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Climate policy: choosing the right instrument to reap an additional employment dividend

Ronnie Schöb
Freie Universität Berlin and CESifo

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Abstract
Climate protection should use environmental policy instruments that raise revenues, which can be used, for instance, to cut labour taxes to alleviate unemployment in economies suffering from high and persistent unemployment. This paper elaborates the possibilities of an employment dividend of climate policies and shows the potential importance of such a second dividend for a comprehensive cost-benefit analysis of climate policy. It is argued that national attempts to reap such a double dividend may be bound to fail if resource suppliers can respond in a way that leads to a large-scale international reallocation of environmental rents. Only a internationally coordinated uniform base tax on CO_2 that complements already existing emission trading systems could keep revenues from climate policy in those countries bearing the cost of fighting global warming and thus leave them with the option on a second dividend.

Keywords: climate policy, double-dividend hypothesis, employment dividend, supplier responses

JEL classification: Q54, H 20

Address

School of Business & Economics, Freie Universität Berlin, Boltzmannstr. 20, D-14195 Berlin, Germany. Email: ronnie.schoeb@fu-berlin.de.

1. Introduction

The EU has promised in the Kyoto Protocol to reduce its CO_2 emissions dioxide (including carbon equivalents of other greenhouse gases) from 1990 to 2012 by 8 percent. The overall environmental target having been proclaimed, national environmental policy is faced with the challenge to meet the respective national emission targets at minimum social cost. The less climate protection costs, the more funds will be available for other environmental, social or economic goals.

The direct costs of reducing CO_2 emission are minimized if the cost of avoiding one ton of CO_2 is the same at every source of emission (see e.g. Baumol and Oates 1988). If this is not the case, costs could be saved by allowing those with higher marginal abatement costs to emit more and – respectively – those with lower marginal abatement costs to emit less. Cost-efficient abatement can be achieved by introducing e.g. a uniform green tax. If, for instance, the government imposes a tax of 30 euros per ton of CO_2, it would be beneficial for each emitter to avoid CO_2 for as long as abatement cost per ton is lower than the corresponding tax rate. The same reasoning applies to tradable emission permits. At a permit price of 30 euros, it would be beneficial for each emitter to buy CO_2 permits for as long as the abatement cost for one ton of CO_2 is higher than 30 euros, irrelevant of whether the government initially distributes permits for free ("grandfathering") or auctions them to the companies (see e.g. Tietenberg 2006a).

But there is a difference with respect to public revenues. While green taxes or auctioned permits generate additional public revenues, the profits gained from grandfathered permits remain with the companies they have initially been distributed to. The difference is not only of distributive importance. If CO_2 prevention can be achieved at minimum cost, it should be done in a way – by using the appropriate environmental instruments – that provides the government with the highest revenues. That way, an additional dividend can be reaped: as long as the government relies on other distortionary taxes to finance its expenses, green taxes as well as auctioned permits not only improve the environment but can be used to lower these other taxes and their disadvantages (see e.g. Schöb 2005).

The attainment of a double dividend – the term traces back to David Pearce (1991) – was explicitly pronounced as part of the German green tax reform in 1999. By introducing the green tax reform, the former red-green German government intended not only to increase the price of energy consumption but to recycle the additional tax revenues by cutting the contribution rate to the old-age pension system. According to the German Ministry of Finance, this double objective was in fact achieved. Thanks to the green tax reform, the contribution rate could be permanently lowered by 1.7 percentage points. The lower labour cost promoted labour demand and thus helped alleviating unemployment. The green tax reform reaped a double dividend as it reduced pollution and promoted employment.

It is, therefore, all the more astonishing that the scope for a second dividend finds no mention in the re-surfaced discussion about cost and benefit of climate protection in the EU. This article reviews the possibilities of combining environmental protection with attaining one particular second dividend, namely an employment dividend in economies suffering from high and persistent unemployment. It aims at renewing the interest in exploring the potentials for a second dividend from environmental policies, taking into account the particularities of internationally coordinated climate policy measures and the joint use of green taxes and emission trading systems.

Following a brief literature review in Section 2, we provide an introduction into the double-dividend theory in the presence of involuntary unemployment in Section 3. In Section 4, we highlight the importance of government revenues by re-interpreting green tax instruments as an indicator for the degree of nationalizing the environment and appropriating the environmental rents. In Section 5, we exemplify the prospects of an employment dividend by looking at the German climate policy. As Section 6 will then demonstrate, the choice of appropriate environmental instruments to raise green revenues may be more limited when we take into account international reactions of the resource markets. Section 7 tries – under the assumption that the right environmental policy instruments are chosen – to quantify the potential employment dividend for Germany, highlighting that the way revenues from environmental policy measures are recycled is essential for the magnitude of an employment dividend. Section 8 briefly concludes.

2. The double-dividend hypothesis: a brief literature review[1]

Since Pigou (1920), it is widely accepted that environmental taxes are an efficient instrument

[1] For more comprehensive surveys about the literature on the double dividend see Bovenberg (1999), Goulder (1997) or Schöb (2005).

to protect the environment, superior to the classical environmental policy instruments of command and control. Furthermore, tax revenues from environmental or green taxes can be used to cut other taxes so that environmental taxes not only improve the environment but also reduce the distortions of existing taxes on e.g. labour and capital income. This idea of a double benefit was first mentioned by Tullock (1967) and has been supported by partial equilibrium models in the eighties, developed by Nichols (1984), Terkla (1984) and Lee and Misiolek (1986). It is now well-known as the double dividend of green taxes. The main implication of this double-dividend hypothesis is that, if there is a general consensus about an environmental target, revenue-raising instruments are preferable to other environmental tax instruments that, although cost-efficient in regulating the environment, do not raise public revenues.

Several authors who, based on the seminal paper by Sandmo (1975), analyzed the double dividend in a general equilibrium framework, were more sceptical (see e.g. Bovenberg and de Mooij (1994), Bovenberg and van der Ploeg (1994a, b, c) and Goulder (1995). Their research shows that increasing a narrow-based green tax and reducing a broad-based tax e.g. on labour income will typically increase the gross distortion of the tax system and conclude

> "that environmental taxes typically exacerbate, rather than alleviate, pre-existing distortions – even if revenues are employed to cut pre-existing distortionary taxes". (Bovenberg and de Mooij 1994, p. 1085).

This statement is certainly true but does not contradict the previous optimistic statement. Using tax revenues from green policy always allows to reduce other distortions. However, if the tax system was optimal without taking into account environmental concerns, total distortions, including the distortion of the green tax, must necessarily increase. While the former result is relevant for policy purposes because it stresses the importance of green revenues, the latter is of more theoretical interest. It implies that, due to pre-existing distortionary taxation, the environmental quality is already closer to the second-best optimum than the laissez-faire situation in a non-distorted economy. Thus, less severe reductions of environmental quality are necessary to reach the optimal environmental level (see Metcalf 2003).

The prospect of a double dividend is not only important for efficiency but also for redistributive reasons. Environmental taxes may have a regressive nature because low-income persons largely consume environmentally harmful goods (see Smith 1992). In this case, redistributive objectives might lower the level of taxes on environmentally harmful commodities and affect the optimal way to reap a second dividend. Secondly, distributive considerations also influence the valuation of environmental damage. While the physical incidence of pollution is typically higher in low-income groups, e.g. due to bad housing situations, people who are well-off tend to put a higher value on environmental quality (see Harrison 1994). While Sandmo (1975) already raised this issue in his seminal paper, only very few papers have taken it on (see Schöb 2005 for further references). They show how redistributive concerns affect the way in which a second dividend can be generated without questioning the possibilities for a second dividend.

Several simulations with numerical general equilibrium models confirm the theoretical insights and show, with particular concern to CO_2 reduction targets that green taxes have, unlike e.g. grandfathered permits, the advantage of generating an additional revenue-recycling effect that allows the government to partly offset the tax base erosion effect (see Goulder, Parry and Burtraw 1997, Goulder, Parry, Williams and Burtraw 1999, Parry, Williams and Goulder 1999). Parry, Williams and Goulder (1999) summarize the results with respect to carbon abatement policies as follows:

> "Carbon taxes, as well as carbon quotas or tradable permits that are auctioned by the government, enjoy the revenue-recycling effect as long as the revenues obtained are used to finance cuts in marginal tax rates of distortionary taxes such as the income tax. In contrast, grandfathered (non-auctioned) carbon quotas and permits fail to raise revenues and thus cannot exploit the revenue-recycling effect. ... the inability to make use of the revenue-recycling effect can put the latter policies at a substantial efficiency disadvantage relative to the former policies" (Parry, Williams and Goulder 1999, p. 53).

It should be mentioned that the government not necessarily needs to actually raise revenues from environmental policy but rather that it can capture the rents generated by the environmental policy (see Fullerton and Metcalf 2001). We come back to this issue in Section 4.

All these results only hold for economies with competitive labour markets and, in so far as cuts in labour taxes were considered, focuses on *labour supply* reactions. For European countries, suffering from high involuntary unemployment due to insufficient labour demand, the more interesting question is in how far green tax reforms could affect *labour demand* to boost employment? This question provoked the search for an employment dividend in its own right. In a model with fixed net-of-tax wages, Bovenberg and van der Ploeg (1996, 1998a) show that if green taxes are low initially, employment may increase if substitution between labour and resources within the production sector is easy. Positive employment effects are also found in a search theoretic framework (see Bovenberg and van der Ploeg 1998b). In models with endogenous wage negotiations between trade unions and firms, Koskela and Schöb (1999) analyze the effects of a revenue-neutral green tax reform, which increases green taxes on the consumption of a polluting good, and show that unemployment is alleviated if unemployment benefits are nominally fixed and taxed at a lower rate than wage income. Koskela, Schöb and Sinn (1998) show in a similar framework that revenue-neutral tax reforms that raise green taxes on energy input and lower labour taxes lead to substitution of labour for energy and reduce marginal production cost for moderate energy tax rates. Both effects lead to an increase in labour demand and thus in employment. This in turn, however, increases the outside option for the trade union and leads to wage increases which, in turn, partly offset the initial employment gains. Holmlund and Kolm (2000) examine the role of environmental tax reforms in a small open economy with monopolistic competition and show for a two-sector economy that a revenue-neutral green tax reform boosts employment if wages in the tradable sector are higher than in the non-traded sector. In a bargaining model where the firm can invest in abatement technologies, Strand (1999) shows that when rebating green tax revenues by either subsidising firms' hiring or investments in abatement, pollution declines while employment may increase.

Carraro, Galeotti and Gallo (1996) provide numerical simulations of the effects of a carbon tax reform in a bargaining model, which indicate some evidence in favour of an employment dividend in the short-run but not necessarily in the long-run (See Bosello, Carraro and Galeotti 2001 for further references).

Maximizing the benefit from the 'double dividend' requires the reduction of the most distortive taxes. In practise, however, revenues from environmental taxes quite often seem to be earmarked to particular green programs. Such earmarking runs counter to standard rules of efficient taxing and spending but may be justified as an instrument to overcome a time-inconsistency problem in environmental policy (Marsiliani, and Renstrom 2000) or may be the outcome of the political process (Bös 2000, Brett and Keen 2002). Although earmarking is inefficient in general, raising green revenues is still beneficial as it generates a non-optimal second dividend by increasing public goods such as environmental quality or improved public transportation.

The brief review illustrates that there are several types of second dividends the government can reap from raising green revenues. In the following, we will focus on only one of them, i.e. the employment dividend. Most of the following discussion, however, easily carries over to other forms of a second dividend, regarding e.g. the deadweight loss of taxation, redistributive aspects or further environmental concerns.

3. The two dividends of environmental policies

To make the two dividends at work more transparent, we present a highly stylized model of an economy that produces one good *Y* that is entirely exported. The revenues are used to import a produced import good, which serves both public and private consumption, and to import a natural resource *R*, needed for production. The price of export good *Y* is *p*, which is measured in terms of a produced import good. This can be interpreted as the economy's "terms of trade". The higher the price *p*, the more the country can buy for a given level of production.

The good *Y* is produced by a single firm that faces monopolistic competition on the world market, i.e. it faces a downward sloping demand for its output.[2] The good *Y* is produced with energy *R*, and labour *L* as inputs. While energy *R* is imported, labour *L* is internationally immobile. Technology is assumed to be linear-homogeneous. The country is 'small' with respect to the resource import *R* so that its demand cannot affect the world market price for the resource. The labour market is characterized by a fixed net-of-tax wage. This may be due to minimum wages, wage bargaining or efficiency wages. This assumption is only made for the sake of the argument, as the results carry over – with some modifications not essential for our argument – to models in which the net-of-tax wage *w* is determined endogenously in wage negotiations between firms and trade unions, or where firms set efficiency wages (see Section 2).

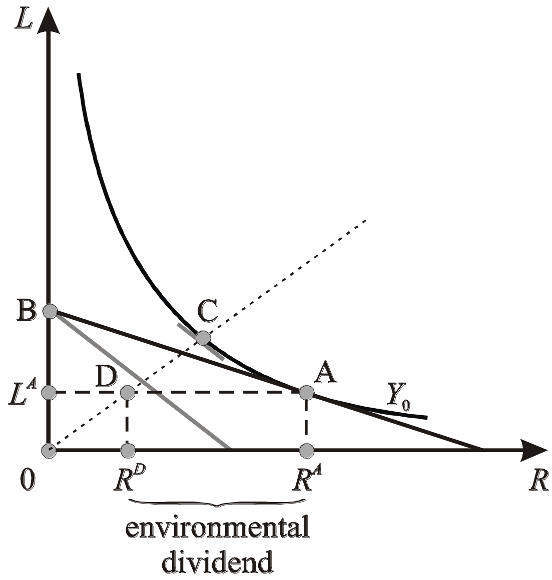
[2] For the following analysis, it is necessary that there are pure economic rents in equilibrium. This can be ensured by either assuming monopolistic competition on the product market or by assuming a third fixed factor. Without profits, it would not be possible to raise the wage above market-clearing levels in a small open economy (see Schöb 2005, p. 244).

The government can tax both energy and labour. Because both net-of-tax factor prices are fixed, the whole tax burden falls on firms so that the firm considers both the gross energy price $\tilde{q} = (1 + t_q)q$ and the gross wage rate $\tilde{w} = (1 + t_w)w$ as given. To guarantee a profit maximum, the output demand elasticity must exceed unity, i.e. $\varepsilon > 1$, in which case profit maximisation implies that the firm will set a price that exceeds the constant marginal costs $c(\tilde{w}, \tilde{q})$ by some mark-up.

There are N workers in the economy, each providing one unit of labour. In the initial equilibrium firms demand only L workers so that there is involuntary unemployment. Furthermore, we assume that the initial equilibrium A is characterized by a tax system where only labour is taxed, i.e. we have $t_w^A > t_q^A > 0$.

In a first step, we consider the introduction of a green tax in isolation. Figure 1 illustrates the case. In the initial equilibrium, the slope of the isoquant Y_0 equals the negative of the ratio of the tax-inclusive factor prices $-\tilde{q}/\tilde{w}$. In the initial equilibrium A we thus observe the factor price ratio $-q/(1 + t_w^A)w$. Since A is a point of tangency between the tax-inclusive isocost curve and the isoquant, it characterises a cost minimum. Given q, w, t_w^A, there are many such cost minima on a ray from the origin through A, all of which have the same unit production cost, but because of the endogeneity of the output price p the monopolistically competitive firm can set, there is only one point that maximises profits, i.e. point A in Figure 1. Total cost of producing Y_0 in units of labour is measured by the distance 0B.

Figure 1: *Introducing a green tax*

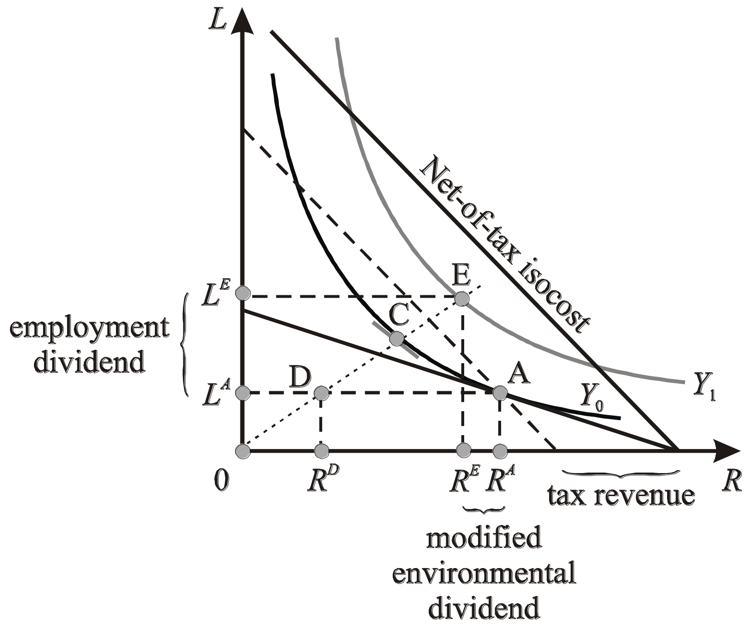


When the government introduces a green tax t_q, the isocost line pivots clockwise in point B, indicating the higher factor-price ratio $-(1+t_q^D)q/(1+t_w^A)w$. At this factor price ratio, the cost-minimizing production of Y_0 would be in point C because of the assumed linear-homogeneity. At point C the firm produces at higher total and thus marginal cost, as can be seen from the fact that the isocost curve through C is above the one through B, which indicates the same total cost as in the initial equilibrium in point A. Profit-maximization will lead the firm to reduce production along the array through C. The point D indicates a new equilibrium. The exact location of D depends on how elastic the demand for the good Y is. The total effect on energy input $R^D - R^A$, which we interpret as the environmental dividend of a green tax, is the sum of substitution and scale effects. The effect on employment is ambiguous. While the substitution effect will raise employment, the scale effect will lower employment. In Figure 1, point D illustrates the special case where the employment effect is identically zero.

The introduction of the tax reform raises revenues from taxing energy while labour tax revenues remain constant. If the government rebates additional tax revenues lump-sum, nothing else would happen in this market. The same is true if we consider a system of grandfathered permits where the price for the R^D permits increases the energy price by $t_q q$. The allocation would be identical but the revenues for the permits would raise the income of those who first received it.

What happens if the government uses the green tax revenues to lower labour taxes? When we reduce the labour tax, the isocost curve would become even steeper since the new labour tax t_w^E would be smaller than the initial labour tax. Rather than looking at a steeper isocost line, for didactical purposes we consider a movement at the isocost curve through point D by looking at tax rate changes that leave the factor price ratio constant. This will be done in Figure 2.

Figure 2: *revenue-neutral introduction of a green tax*

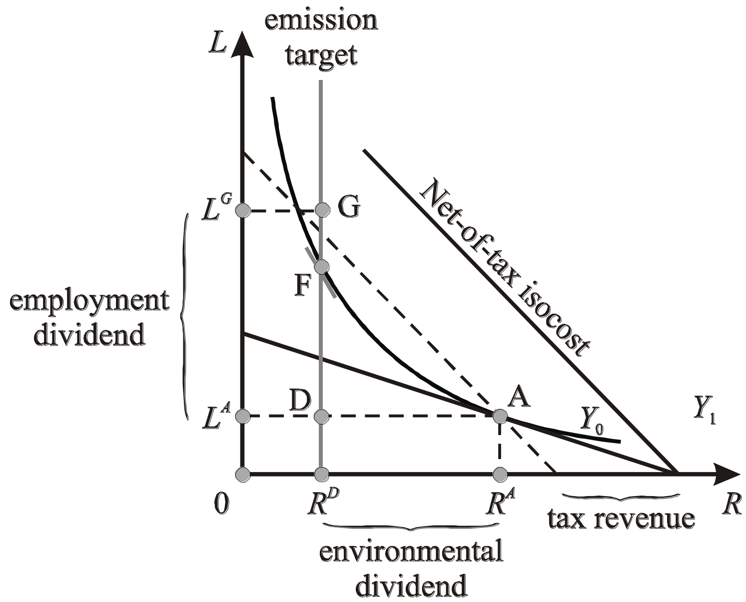


The curve on the very right-hand side of Figure 2 shows the net-of-tax isocost curve, which is defined as the geometrical locus of factor combinations that would be attainable at a given expense if there were no taxes at all. The slope is given by q/w. The net-of-tax isocost curve through A is steeper than the tax-inclusive isocost through A because $t_w^A > 0$, and thus $q/(1+t_w^A)w > q/w$. The horizontal distance between A and the net-of-tax isocost equals the government's tax revenue in terms of *R*. The broken parallel to the net-of-tax isocost through A thus defines the geometrical locus of all potential equilibria, where tax revenue and net-of-tax factor expenses are the same as in the labour-tax regime A when total cost are kept constant.

In a first step, the government has introduced the green tax as in Figure 1, reaching point D. Assume that the government, in a second step, reduces both tax rates such that the factor price ratio remains the same as in point D. Total cost and marginal cost fall and the firm will raise production. At point C, the tax rates would be so low that it becomes optimal again for the firm to produce Y_0, but with more labour and less energy. In this point, total and marginal cost would be the same as before but government revenues would still be higher than in A, because C is to the right of the net-of-tax isocost through A. Hence, the government can further reduce both taxes, shifting the new equilibrium further to the north-east along the array through D. Point E represents a possible equilibrium. In point E, we have the same tax revenues as in A but with a higher tax on energy and a lower tax on labour.

Moving from A to E thus represents a revenue-neutral green tax reform. Concerning the environmental dividend, the positive scale effect would work against the substitution effect so that the environmental dividend of a comprehensive green tax reform is actually smaller than the environmental effect of an isolated increase in the green tax. With respect to employment, however, the scale effect now produces a strictly positive effect: by using the green tax revenues to reduce labour taxes, the government can reap a positive employment dividend. Note that because of the higher output, total domestic income also increases.[3]

Figure 3: *auctioning off permits*



Qualitatively the same result would occur if the government auctioned off R^D permits.[4] If domestic energy consumption is fixed to R^D, any rebate of the auction revenues would

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[3] For further elaboration, see Koskela, Schöb and Sinn (1998).

[4] If it would auction off R^E permits we would obtain the identical allocation.

increase the demand for energy and, because of the inelastic supply, the price for the permits would further rise. In Figure 3, this would lead to a move along the vertical line through D. In point F, the firms would produce the same output as in point A, but the government would still run a budget surplus and would continue to lower labour taxes. Point G above the Y_0 isoquant may represent a new equilibrium where the firm produces a higher output at lower marginal cost. The distance DG represents the employment dividend when the environmental dividend is fixed to $R^A - R^D$. If we compare Figures 2 and 3, it becomes obvious that a stricter environmental policy may allow the government to increase both dividends – as long as the economy does not reach full employment. Comparing both figures with Figure 1 illustrates the importance of public revenues for the overall efficiency of climate policy. It is thus worth giving this role some second thoughts.

4. The role of public revenues

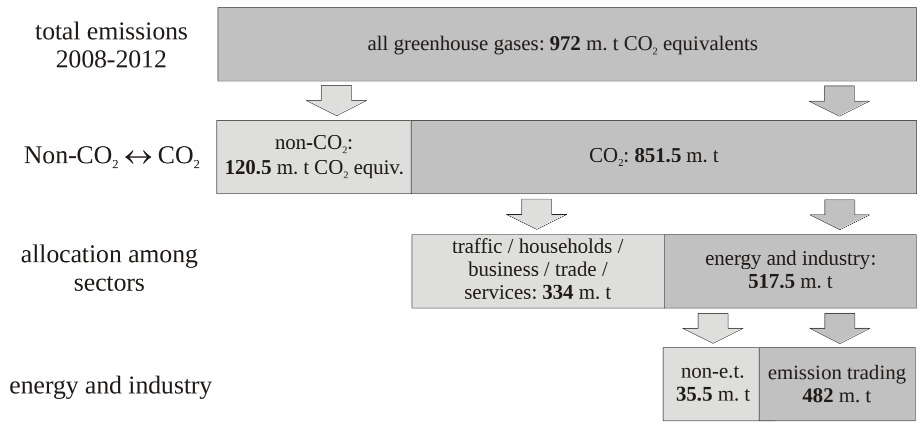
Who owns the environment and who has a right to exploit it? As long as we take no climate protection measures, we leave the environment to the polluters: they are free to emit as much CO_2 as they like; they take advantage by exploiting the environment without considering the costs they impose on others. They possess the (implicit) habitual right to the environment. In the first place, any environmental policy deprives the polluters of their „property rights“, it forbids them to further exploit the environment. To put it differently: environmental policy first of all implies the nationalization of the environment (cf. Schöb 1996).

The choice of the environmental instrument – be it a charge, a green tax, a subsidy or a permit – determines to which extent the state then re-privatizes the rights to the environment. Green taxes as well as the complete auctioning of CO_2 certificates leaves the property rights in the hands of the government, it extracts all rents from the exploitation of these rights. By contrast, in the case of grandfathered permits, the government receives no income from granting CO_2 emission rights to polluters. This is like a partial re-privatization, given the amount of permits. With the proclaimed 8 percent reduction in mind and 92 percent state-issued permits, the initial full nationalization of the environment is redone with a 92 percent re-privatization. The EU’s waiving of the remaining 8 percent benefits those who suffer from climate change. To the extent to which the state no longer issues permits for free but auctions them off, it reduces the degree of re-privatization and raises public revenues from environmental exploitation. Public revenues from environmental policies thus indicate to which extent the environment is nationalized. Whereas the degree of nationalization is irrelevant for cost efficiency, it affects the government's options to generate new sources of income and, consequently, a second dividend. The role of nationalization for reaping a second dividend, namely an employment dividend, is exemplified in what follows for the German climate policy. We proceed in two steps. First, we look at national climate policy in isolation and identify those policy instruments that may maximize the employment dividend. Then we include potential responses of international resource suppliers and show that in this case only a subset of instruments may continue to reap an employment dividend.

5. The German national allocation plan and public revenues

Germany has vowed to reduce its greenhouse gas emissions by 21 percent relative to the year 1990. This objective is manifested in a national allocation plan. The allocation plan for the years 2008 – 2012 – illustrated in Figure 4 – determines the allocation of the total national emission budget for the next five years.

Figure 4: *The national allocation plan 2008-2012*



Source: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (2006, S. 19)

According to the national allocation plan 2008-2012, a total of 851.5 million tons of CO_2 may be emitted per year. Other greenhouse gases can be emitted up to an amount having the same effect on the climate as the emission of 120.5 million tons of CO_2. The permitted CO_2 emissions are being allocated to the aggregate sectors „traffic, private households, business, trade, services“ and „energy and industry“. In the first sector, 334 million tons of CO_2 per year may be emitted, 517.5 million tons of CO_2 in the second sector. The strict classification as non-CO_2-gases and CO_2 as well as the strict allocation of the CO_2 emissions to both sectors prevent an equilibrium of the marginal abatement costs among individual emitters and thus fail to achieve cost-efficient avoidance.

Within the sector „traffic, private households, business, trade and services". energy consumption is taxed by special green taxes already introduced stepwise since 1999.[5] As a result – despite many exceptions – the exploitation rights and the corresponding income are being transferred to the state. As estimated by the Ministry of Finance, such income will amount to approx. 19 billion euros for the year 2008. For the sector „energy and industry", the total amount of 482 million tons of CO_2 per year will be allocated by emission trading, 90 percent of which will be grandfathered to existing firms.

Figure 5: *Emission trading*

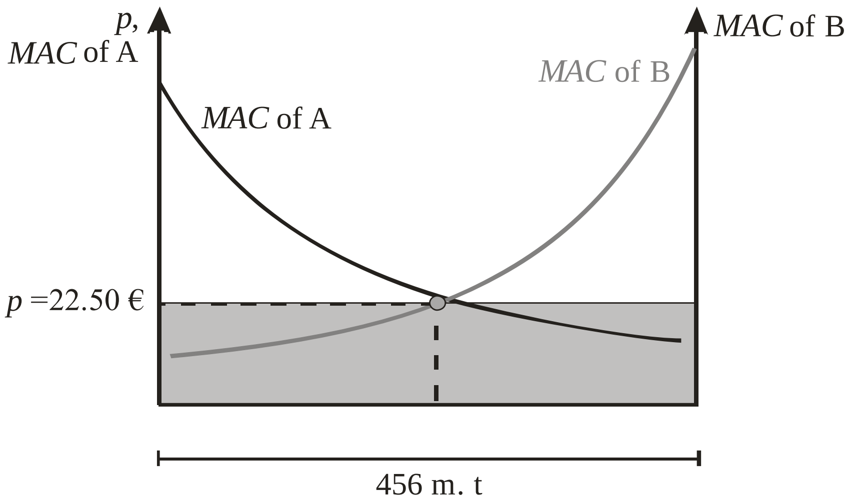


Figure 5 models emission trading for two representative emitters and shows the development of the permit price in emission trading. The horizontal axis indicates the total emission amount to be allocated.[6] The amount allocated to emitter A is plotted from left to right, the amount allocated to emitter B from right to left. The decreasing curve shows the marginal abatement cost (*MAC*) for emitter A, i.e. the cost of abating one additional ton of CO_2. When emitting large amounts (we are far off to the right), the marginal abatement cost of avoiding one ton of CO_2 is still very low. The more A already avoids, the higher the marginal

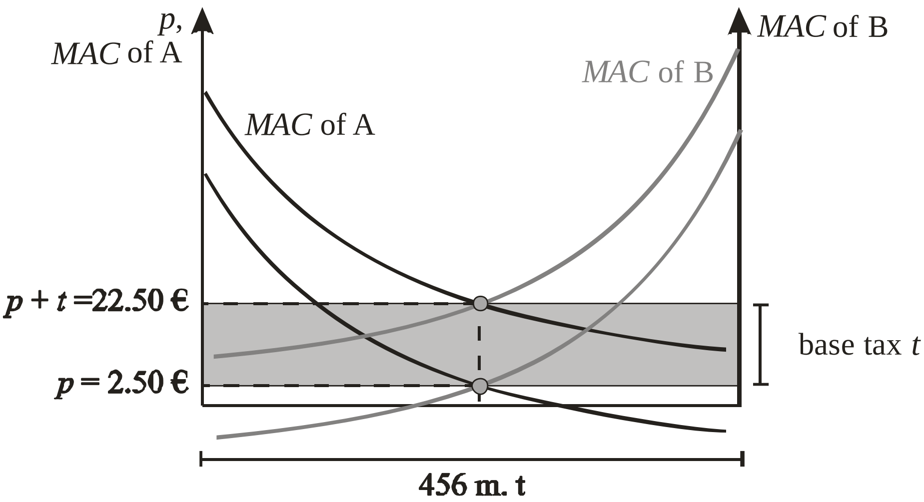
[5] For a critical assessment see Böhringer and Schwager (2003).
[6] Contrary to Figure 4, the emission trading volume as reduced by the revision of the national allocation plan of only 456 million tons of CO_2 is being considered here.

abatement cost become. The curve for emitter B is mirror-inverted. If the marginal abatement cost for avoiding one ton of CO_2 is higher than the permit price, it pays to buy emission permits; if it's lower, it does not. The two marginal abatement cost curves thus represent the demand for permits by the two emitters. Trading the emission rights leads to the formation of a market price, which in September 2008 was at about 22.50 euros per ton of CO_2[7] , and guarantees that the two emitters abate CO_2 at minimum social cost.

According to the German Minister for the Environment, Sigmar Gabriel, today 10 percent of the permits are being auctioned off by the government – the maximum allowed by the EU. However, it is his proclaimed goal to auction off all permits from 2013 on, the start of the third national allocation plan. Assuming today's permit price of 22.50 euros per ton of CO_2, the current public revenues from auctioning off permits amount to approx. 1 billion euros which would rise to approx. 10.2 billion euros per year with full auctioning. The grey area shows the maximum potential additional public revenues: full auctioning may yield an additional 9.2 billion euros per year in tax income.

Instead of auctioning off the emission rights, the state could also impose a base tax on CO_2 emissions in the sector „energy and industry". At a tax of e.g. 20 euros the companies' willingness to pay for permits would fall by 20 euros per ton of CO_2, since they now compare the permit price plus tax with their own marginal abatement cost. The permit price will fall accordingly, as shown in Figure 6.

Figure 6: *emission trading and base tax*



[7] Current permit prices can be viewed at http://www.eex.com/de.

From a national point of view, any combination of a base tax and permit trading will lead to the same allocation as a pure emission trading system and yield the same additional amount of public revenues. As we will see in the next paragraph, this is no longer true when taking into account international reactions.

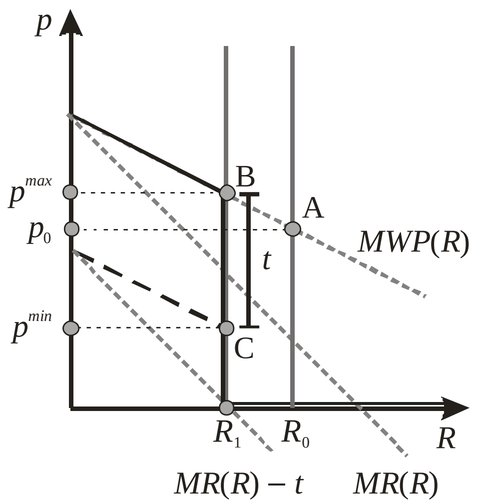
6. Suppliers response

CO_2 emissions are strongly tied to the use of exhaustible resources. A comprehensive analysis of climate policy should therefore take into account the impact of green taxes on the world producer prices of exhaustible resources such as gas and oil products (see Amundsen and Schöb 1999). Since this paper focuses on the prospects of a second dividend, it is not the place to elaborate the consequences for the efficiency of environmental policy measures. This has been thoroughly discussed in Sinn (2008). The focus of this paper is on the international tax incidence: suppliers' responses may have severe impacts on national public revenues in countries that agree upon CO_2 emission reduction targets and thus affect the prospects to reap a second dividend. As it turns out, not all of the instruments discussed in the last section that guarantee an employment dividend may be equally efficient when supplier responses are taken into account. This section thus wants to broaden the analysis of the question as to how climate policy can be designed to maximize the potential of reaping an employment dividend.

Resource prices are principally determined by the user cost of the resource, i.e. the rent the resource owner obtains from extracting the resource (see e.g. Tietenberg 2006b). An energy tax, introduced by a sole country with a negligible share in global energy demand, does not affect the world energy price. It is therefore optimal for such a small country to proceed as described in the last subsection and try to maximize its public revenues. For the welfare analysis it is not necessary to incorporate the reactions on the world resource markets.

If, as in the case of climate policy, *all* countries introduced CO_2 emission targets, world demand for non-renewable resources, e.g. oil, would change quite dramatically and resource-extracting countries might react accordingly. The main underlying idea can again be described graphically. For simplicity, assume first that the whole oil stock can be used in one period only. If we abstract from extraction costs, this implies that consumers face a fixed supply R_0. In the absence of pollution, it is optimal to extract the whole oil stock if the marginal willingness to pay at R_0, $MWP(R_0)$ is positive.

Figure 7: *Reduction of supply on the oil market*



In Figure 7, the initial equilibrium is shown by point A. All oil is extracted and sold at price p_0. If all the oil-consuming countries agree on a common climate policy that only allows the consumption of R_1, the determination of a global CO_2 reduction goal automatically reduces global resource demand. The marginal willingness to pay for the resource drops from $MWP(R_1)$ to zero to the right of R_1.

The kinked bold curve illustrates the new demand curve. How will the resource suppliers react? This, of course, depends on the market structure and the way in which suppliers compete. But at least for a monopolistic supplier, we can illustrate the optimal response. The monopolist will reduce extraction from R_0 to R_1 and offer this quantity at a fixed price $p^{\max} = MWP(R_1)$ as long as marginal revenues $MR(R_1)$ are still positive. At this price, the oil-consuming countries exactly demand the quantity of the resource that is allowed by an international climate policy agreement through emission trading. Accordingly, the price of emission permits drops to zero. The total revenues from the oil market are reaped by the monopolist, e.g. the OPEC, and the oil-consuming countries are left with no public revenues from their green policy and thus cannot reap any employment dividend. A pure emission trading system with auctioned permits thus runs the risk of the oil-extracting countries extracting the whole environmental rent.

This vanishing of a second dividend can be avoided by levying a base-tax. If the oil-importing countries not only agree on a reduction target $R_0 - R_1$ but also on a uniform base tax t = BC, the OPEC will continue to sell the whole quantity R_1 [8] but can only charge a price

[8] This is the case as long as marginal revenues are positive at R_1.

$p^{\min} = MWP(R_1) - t$. It will only reduce supply if marginal revenues for the OPEC at R_1 were negative: the optimal tax t for a given emission reduction target is thus given by $t = MR(R_1)$. Such a policy guarantees the oil-consuming countries to keep tax revenues equal to $t \cdot R_1$ – without affecting the allocation. A base tax can thus ensure that the international tax incidence is shifted back to the oil-consuming countries, and to the public sector there. The employment dividend as explained in the last section thus remains possible to the extent the base tax allows the oil-consuming countries to fully extract the scarcity rent from introducing an emission reduction target. This is an idea that traces back to Bergstrom (1982) and has been explored for green taxes in Amundsen and Schöb (1999).

To summarize: A second dividend can only be realized for the oil-importing countries to the extent their governments employ environmental instruments that generate domestic public revenues. From a purely national point of view, it makes no difference whether the government auctions off permits or prices them directly by imposing an additional base tax. In an international context, however, the advantages clearly lie in a base tax. A base tax only will enable the countries who actively participate in climate protection to also profit from it, in the sense that social costs induced by their climate policies are minimized. Since the introduction of a base tax is beneficial if resource owners can attract part of the resource rents and, at the worst, is equally good as auctioned permits, a base tax as a complement to already existing emission trading systems is of vital importance for those countries that engage in climate protection and want to do so at minimum domestic cost.

The importance of an employment dividend shall be illustrated in the next section by looking at the prospects of an employment dividend for Germany.

7. An illustration: an employment dividend for Germany

As we have previously seen, the government can maximize its income from emission trading by raising an additional income of 9.2 billion euros per year when it auctions off all permits at the current price of 22.50 euros per ton of CO_2. However, these additional public revenues are partially offset by tax losses. As long as permits are issued to the companies for free, their profits increase by 9.2 billion euros. If the permits will be auctioned, the firms' profits will sink at the same amount by which public revenues rise, and consequently also profit tax revenues. Assuming an average tax rate of 30 percent, tax losses in the amount of 2.8 billion euros are to be set against. That leaves a net 6.3 billion euros to be used to reduce other taxes.[9]

A first alternative would be, along the lines of the German green tax reform of 1999, to use the additional tax revenues to reduce old-age insurance rates. In 2007, the income from national old-age pension scheme amounted to 8.7 billion euros per percentage point contribution rate. Accordingly, the additional net revenues from the auctioned emission rights allow the government to cut the old-age insurance contribution rate from currently 19.9 percent to 19.2 percent.

In order to determine the employment effect, at least two points are to be considered. First, the incidence of the cut of the old-age insurance contribution rate matters. The companies will only expand their labour demand to the extent at which lower contribution rates lower their wage costs. If the whole incidence falls on gross wages, these costs would sink by 0.62 percent. Second, the total employment effect depends on the labour demand elasticity. It indicates the percentage increase in employment in case of a one percent reduction in wage cost. For our simple model calculation we assume three different scenarios with different demand elasticities: –0,5, –0,75, and –1,0.

If the whole incidence falls on gross wages, the employment effect would be between 110.000 and 220.000. The intermediate scenario with a labour demand elasticity of –0.75 would promise 162.000 additional jobs. In this scenario, the maximum employment dividend possible would increase the German labour force by almost 0.5 percent. If the whole incidence falls on net wages the employment effect would be zero but labour income would rise.

Alternatively, one could target the subsidies on the low-wage sector as unemployment is the highest in this sector. Following the suggestion by Knabe and Schöb (2008) to fully subsidize social insurance rates paid by the employer for hourly wages below a threshold wage rate, and then to linearly melt off this subsidy up to 1.5 times the hourly wage, significantly higher employment effects could be achieved.

To simulate the consequences of such a wage subsidy scheme being introduced in the current German welfare system, we use the distribution of gross hourly wages among

[9] Considering the international reactions of a coordinated emission trade policy, grandfathered permits could prove to be of no value. In this case, no tax losses ought to be set off.

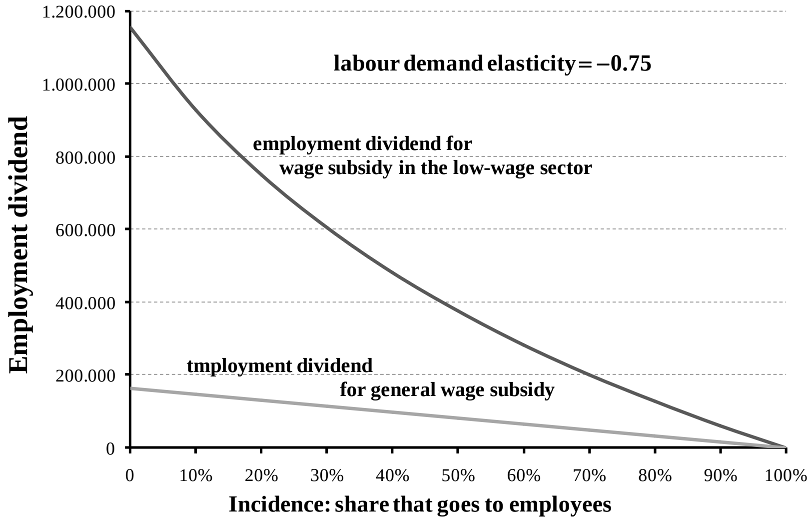
different types of employees derived from the German Socio-Economic Panel (GSOEP) wave 2006.[10] We consider all full-time or part-time employees or those who work in a so-called “minijob” (jobs paid at less than 400 euros per month are partially exempted from social security contributions and taxes). Hourly wages are calculated by dividing reported gross income by the number of reported paid hours (contracted plus paid overtime hours). For all calculated wages below 3 euros, we assume an average hourly wage of 2.75 euros to account for measurement errors in the hours and wage data.

Knowing the wage distribution and being able to calculate how employment changes affect the public budget, we can simulate the effect of a low wage subsidy as described above. For the intermediate scenario with a labour demand elasticity of −0.75, the corresponding potential employment dividend is illustrated in Figure 9. The threshold wage is thereby determined such that auction revenues are rebated in a revenue-neutral way through this subsidy scheme. Lower wage cost at the lower end of the wage distribution could create up to 1.2 million new jobs in the low-wage sector (or 750,000 full-time equivalent jobs) in areas with an hourly gross wage of less than 12 euros.

In the second scenario with low wage subsidies, the employment effect is seven times as high as with a uniform reduction wage subsidy when the whole incidence falls on the employer. The more efficiently additional public revenues from climate protection policy are used to follow other goals – in this case to increase and ensure employment – the higher the second employment dividend, and as a consequence, the higher political acceptance of climate policy may become.

[10] For a detailed description of the GSOEP, see Wagner et al. (2007) and for details underlying the simulation results presented here, see Knabe and Schöb (2008).

Figure 9: *low-wage subsidies and the employment dividend*



As it turns out, the benefits of using green revenues from climate policy measures to reduce CO_2 emissions may have a huge impact on the labour market. This section thus illustrates how important it is to include the prospects of a second dividend such as the employment dividend in a comprehensive cost-benefit analysis of climate policy. Furthermore, it becomes transparent that the scope for an employment dividend essentially depends not only on whether climate policy generates public revenues that allow the government to lower wage costs, but also on institutional factors such as the bargaining system that in our example determines the incidence of wage subsidization, and on the technology that determines how elastic labour demand reacts to such a policy.

8. Conclusion

Climate protection goals should be achieved at minimum possible economic cost. This requires cost-efficient environmental policy measures that ensure that marginal abatement costs are equalized among all emitters. But that alone does not exhaust the full potential. A second dividend can be gained with a climate policy designed to ensure that income from environmental regulation goes to the public purse. At the same time, however, any isolated attempt by a single nation may be bound to fail. The risk that resource suppliers respond in a way that leads to a large-scale international reallocation of income – i.e. from oil-consuming to oil-producing countries – simply is too high. Avoiding this requires international coordination of emission reduction targets as well as of the instruments used. As proposed in this article, an internationally set uniform base tax could ensure that revenues from climate policy remain in the oil-consuming countries and, thus, provide them with the option on a second dividend. How and to which extent such a second dividend can be realized will then be up to each country.

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